

**WHAT IS CLAIMED IS:**

1. A bar code scanner, comprising:

(a) a housing including: (i) a substantially omnidirectional laser scanning platform mounted therein, (ii) a window for admitting laser energy into the housing and for allowing laser energy to pass out of the housing; and (iii) a shock-absorbing mechanism in the form of a protective sheath that functions to protect against damage if the bar code scanner is dropped and/or subjected to mechanical shock;

and

(b) a movable bracket adjustably mounted to the housing such that, if the movable bracket is mounted to a fixed surface, the movable bracket remains fixed, but permits adjustment of housing to any of a plurality of positions relative to the fixed surface.

2. The bar code scanner of claim 1 wherein the protective sheath is fabricated of rubber and/or flexible plastic.

3. The bar code scanner of claim 2 wherein the protective sheath is fabricated so as to permit removal of the sheath from the housing.

4. The bar code scanner of claim 1 wherein the protective sheath includes an opening such that, when the protective sheath is installed on the housing, the opening substantially coincides with the window.

5. The bar code scanner of claim 2 wherein the protective sheath is a substantially

permanent part of the housing.

6. The bar code scanner of claim 2 wherein the housing defines an approximate cubic volume having an upper surface with four upper corners and a lower surface with four lower corners.

7. The bar code scanner of claim 6 wherein the protective sheath protects the four upper corners and four lower corners of the bar code scanner.

8. The bar code scanner of claim 2 wherein the housing is provided with top-mounted, front-mounted, or side-mounted LED power and/or LED "good bar code read" indicators.

9. The bar code scanner of claim 2 wherein the housing is molded of hard plastic.

10. The bar code scanner of claim 9 wherein the housing is formed in two half-sections with tongue-and-groove edges to provide an interlocking fit.

11. The bar code scanner of claim 2 wherein the window is generally square and/or rectangular in configuration and mounted in an aperture of the housing.

12. The bar code scanner of claim 11 wherein the window is seated in, and/or held by, one or more grooves or projections formed in the housing.

13. The bar code scanner of claim 12 wherein the window is fabricated of a square and/or rectangular section of transparent acrylic-type plastic with optical filtering properties.

14. The bar code scanner of claim 1 wherein the movable bracket includes a position adjustment mechanism providing position adjustment of the housing relative to the bracket about a rotational axis  $a - a'$ .

15. The bar code scanner of claim 14 wherein the position adjustment mechanism is provided in the form of an annular flange having an inner diameter and an outer diameter.

16. The bar code scanner of claim 15 wherein, along an interior (inner) surface of the annular flange proximate to the housing, between the inner and outer diameters, are provided one or more projections, notches, ridges, grooves, nubs, fingers, detents, and/or bosses that engage one or more corresponding mating structures on the housing.

17. The bar code scanner of claim 16 wherein the one or more projections, notches, ridges, grooves, nubs, fingers, detents, and/or bosses are provided in the form of a plurality of rounded teeth that engage one or more corresponding rounded grooves of the housing.

18. The bar code scanner of claim 14 wherein the movable bracket includes two or more mounting holes for mounting to a surface such as a countertop and/or point of sale terminal.

19. The bar code scanner of claim 14 wherein the protective sheath is provided in the form of a removable and reinstallable encasement fabricated of a rubberized shock-absorbing material.

20. The bar code scanner of claim 3 wherein the protective sheath includes one or more projections and mating notches, each notch mating with a corresponding projection, so as to facilitate quick and easy removal and/or installation of the protective sheath on the housing.

21. The bar code scanner of claim 3 wherein the protective sheath is removable from, and reinstallable on, the housing, without the use of any projections or notches, by a mechanical flexure of the protective sheath.

22.. The bar code scanner of claim 1 adapted to perform scanning operations from a hand-held position, a free-standing position, and a fix-mounted position; wherein the hand-held

and free-standing positions are achieved by permitting the removable bracket to rest upon a surface but wherein the bracket is not attached to the surface; and wherein the fix-mounted  
5 position is achieved by mounting the bracket to the surface.

23. The bar code scanner of claim 1 adapted to perform scanning operations from a hand-held position, a free-standing position, and a fix-mounted position; wherein the removable bracket is attached to the surface and at least one of the hand-held position and the free-standing position is achieved by removing the housing from the removable bracket.

24. The bar code scanner of claim 1 wherein the scanning platform includes an object detection circuit for detecting and determining the presence of an object within an operative scanning range.

25. The bar code scanner of claim 22, wherein the housing and the scanning platform provide a substantially omnidirectional scan from a free-standing fixed position atop a counter or while handheld by a user.

26. The bar code scanner of claim 23, wherein the housing and the scanning platform provide a substantially omnidirectional scan from a free-standing position fixed atop a counter or while handheld by a user.

27. The bar code scanner of claim 1 wherein the removable bracket has a flat bottom configured for placement directly on a counter-top surface.

28. The bar code scanner of claim 1 wherein the housing has a substantially flat bottom configured for placement directly on a counter-top surface.

29. The bar code scanner of claim 1 wherein the movable bracket is detachable from the housing.

30. A bar code scanner comprising:

a scanner housing having an approximately cubical volume and comprising:

(a) a light transmission aperture;

(b) an adjustable mounting bracket removably attached to the scanner housing; wherein

5 the housing is equipped with a shock-absorbing mechanism in the form of a protective sheath that functions to protect against damage if the bar code scanner is dropped and/or subjected to mechanical shock;

(c) an omnidirectional laser scanning engine mounted within the housing and including:

(i) a laser beam producing mechanism for producing a laser beam,

10 (ii) a laser beam sweeping mechanism having at least first, second and third light reflective surfaces each being disposed at a different acute angle with respect to a rotational axis of the laser beam sweeping mechanism for sequentially sweeping the laser beam about the rotational axis along a plurality of different paths,

15 (iii) a stationary array of at least first second, third and fourth light reflective surfaces;

(iv) a laser light collection subsystem, including a light collection element for collecting return laser light, the light collection subsystem further including a light receiving mechanism for detecting the collected return laser light and producing an electrical signal indicative of the detected laser light,

20 (v) a signal processing mechanism for processing the electrical signal and producing scan data representative of a scanned code symbol, and

(vi) a control mechanism for controlling the operation of the omnidirectional laser

scanning engine.

31. The bar code scanner of claim 30, wherein a beam directing element is mounted to the light collection element for folding the laser beam in the housing.

32. The bar code scanner of claim 30 further comprising:  
an object detection mechanism mounted in the housing for detecting an object located in an object detection field defined external to the housing and for generating a first activation signal for transmission to the control mechanism, whereby the laser beam producing mechanism, the laser beam sweeping mechanism, the light receiving mechanism and the signal processing mechanism are automatically activated upon the detection of the object.

33. A laser scanner comprising:

(a) a hand-supportable housing having a light transmission window through which laser light can exit the hand-supportable housing, travel towards an object bearing a code symbol and reflect therefrom, and at least a portion of the reflected laser light travel back through the light transmission window and enter the hand-supportable housing; wherein the housing is equipped with a shock-absorbing mechanism in the form of a protective sheath that functions to protect against damage if the laser scanner is dropped and/or subjected to mechanical shock; the hand-supportable housing having a longitudinal extent which extends along a central reference axis;

(b) a movable bracket adjustably mounted to the housing such that, if the movable bracket is mounted to a fixed surface, the movable bracket remains fixed, but permits adjustment of housing to any of a plurality of positions relative to the fixed surface;

(c) a laser beam producing mechanism disposed within the hand-supportable housing for producing a laser beam;

(d) a laser beam sweeping mechanism mounted within the hand-supportable housing for  
15 rotation about a rotational axis intersecting the central reference axis, where the intersection of  
the rotational axis and the central reference axis defines a central reference plane which extends  
along the longitudinal extent of the hand-supportable housing;

the laser beam sweeping mechanism having a plurality of rotating light reflective surfaces  
each being disposed at a different acute angle with respect to the rotational axis, for sequentially  
20 sweeping the laser beam about the rotational axis along a plurality of different paths;

(e) a stationary array comprised of a plurality of stationary light reflective surfaces  
mounted within the hand-supportable housing with respect to the central reference axis and  
disposed substantially under the light transmission window; wherein at least two of the plurality  
of the stationary light reflective surfaces are symmetrically disposed on opposite sides of the  
25 central reference plane, and closely adjacent the laser beam sweeping mechanism;

(f) a light collection subsystem disposed within the hand-supportable housing, and  
including

(1) a light collection element, mounted along the central reference plane and adjacent at  
least two of the stationary light reflective surfaces, for allowing the laser beam produced from the  
30 laser beam producing mechanism to pass along a portion of the central reference plane, to the  
laser beam sweeping mechanism, for sweeping about the rotational axis thereof along the  
plurality of different paths, and

(2) a light receiver for receiving light from the light collection element at a point  
substantially within the central reference plane, and detecting the received light and producing an  
35 electrical signal indicative of the detected light;

(g) a signal processor disposed within the hand-supportable housing, for processing the electrical signal and producing scan data representative of a scanned code symbol;

(h) a control mechanism within the hand-supportable housing for controlling the operation of the hand-supportable laser scanner so that, during scanner operation, the laser beam  
40 produced from the laser beam producing mechanism passes along a portion of the central reference plane, to at least one of the rotating light reflective surfaces of the laser beam sweeping mechanism, and as the laser beam sequentially reflects off a plurality of the rotating light reflective surfaces, the laser beam is repeatedly swept across a plurality of the stationary light reflective surfaces, thereby producing a plurality of groups of plural scan lines, respectively,  
45 which are projected out through the light transmission window and intersect about a projection axis within an approximately collimated, frustal, and/or pyramidal scanning volume having an approximately columnar extent and extending from adjacent the light transmission window to at least about six inches therefrom so as to produce a collimated projected scanning pattern; and

(i) the hand-supportable housing being supportable relative to an object bearing a code  
50 symbol so that when a code symbol is presented within the collimated scanning volume, the code symbol is scanned omnidirectionally by the collimated scanning pattern,

(ii) at least a portion of the laser light reflected from the scanned code symbol is directed through the light transmission window, reflected off at least one of the stationary light reflective surfaces, and then reflected off at least one of the rotating light reflective surfaces of the laser  
55 beam sweeping mechanism, and

(iii) thereafter the reflected laser light is collected by the light collection element, and received by the light receiver for detection, whereupon the electrical signal is produced for



processing by the signal processor;

wherein the hand-supportable housing allows the user to control the direction of the  
60 projection axis by adjusting the movable bracket relative to the housing and observing the  
window of the housing, to thus align the collimated scanning volume with the bar code symbol  
on the object to be scanned and identified.

34. The laser scanner of claim 33, wherein the signal processor further comprises a data  
processor for decoding the scan data and producing data representative of the scanned code  
symbol.

35. The laser scanner of claim 33, wherein the different acute angles are selected so that  
the scan lines in each group of scan lines are substantially equidistant from each other throughout  
at least a range of distances from the light transmission window.

36. The laser scanner of claim 33, wherein the laser beam producing mechanism  
comprises a laser diode mounted with respect to the central reference axis.

37. The laser scanner of claim 33, wherein the first, second, third, and fourth stationary  
light reflective surfaces comprise first, second, third, and fourth mirrors, respectively.

38. The laser scanner of claim 33, wherein the collimated scanning pattern is oriented  
along the longitudinal extent of the hand-supportable housing and exits the window in a direction  
substantially normal to the window so as to facilitate scanning of code symbols presented to the  
collimated scanning volume.

39. The laser scanner of claim 33 wherein the movable stand is positionable upon a  
counter surface, and includes a position adjustment mechanism for supporting the hand-  
supportable housing in any one of a plurality of positions above the counter surface so that the

collimated scanning pattern is projected about the projection axis above the counter surface in  
5 any one of a plurality of orientations corresponding to the plurality of positions.

40. The laser scanner of claim 33, wherein the light receiver comprises a photodetector.

41. The laser scanner of claim 40, wherein the photodetector is located on a circuit board,  
at a height above the laser beam sweeping mechanism, and substantially within the central  
reference plane.

42. The laser scanner of claim 33, wherein the code symbol is a bar code symbol.

43. The laser scanner of claim 33, wherein the light collecting element is a light  
collecting mirror having a focal distance, substantially at which the light receiver is located.

44. The laser scanner of claim 33, wherein

each scan line in a first group of scan lines is substantially parallel to each other scan line  
in the first group of scan lines, and

each scan line in a second group of scan lines is substantially parallel to each other scan  
5 line in the second group of scan lines.

45. An automatic projection laser scanning system comprising:

a hand-supportable housing having a light transmission aperture through which visible  
light can exit and enter into the hand-supportable housing; wherein the housing is equipped with  
a shock-absorbing mechanism in the form of a protective sheath that functions to protect against  
5 damage if the bar code scanner is dropped and/or subjected to mechanical shock;

a movable bracket adjustably mounted to the housing such that, if the movable bracket is  
mounted to a fixed surface, the movable bracket remains fixed, but permits adjustment of  
housing to any of a plurality of positions relative to the fixed surface;

an object detector in the hand-supportable housing, for detecting an object located in a  
10 scanning volume extending externally from the hand supportable housing, and automatically  
generating an activation signal in response to the detection of the object located therein;

an activatable scan data reading mechanism in the hand-supportable housing, for reading  
scan data from a detected object located in the scanning volume, the scan data reading  
mechanism including:

15 a laser beam generator for generating a visible laser beam and directing the visible laser  
beam through the light transmission aperture and into the scanning volume,

a laser beam scanner for repeatedly scanning the visible laser beam so as to produce a  
highly collimated scanning pattern of approximately columnar extent within the scanning  
volume, for scanning a code symbol on the detected object presented therein,

20 a laser light detector for detecting the intensity of laser light reflected off the bar code  
symbol and passing through the light transmission aperture as the visible laser beam is repeatedly  
scanned within the scanning volume, and

a receiver for automatically producing scan data indicative of the detected intensity;

an activatable scan data processor for processing produced scan data so as to detect and  
25 decode the bar code symbol on the detected object, and automatically producing symbol  
character data representative of the decoded bar code symbol; and

a control mechanism for controlling the operation of the automatic bar code symbol  
reading system;

wherein the movable bracket allows the user to control the direction of the projection axis  
30 by adjusting the position of the hand-supportable housing relative to the bracket, and thus align

the approximately columnar scanning volume with the bar code symbol on the object to be scanned and identified.

46. The automatic projection laser scanning system of claim 45, wherein the laser beam generator comprises a laser diode.

47. The automatic projection laser scanning system of claim 45, wherein the bar code symbol has first and second envelope borders, and wherein the scan data processor comprises a detector adapted to detect the first and second envelope borders of the bar code symbol, and a mechanism for decoding the detected bar code symbol.

48. The automatic projection laser scanning system of claim 45, wherein the object detector comprises a receiver for receiving energy reflected from an object within an object detection field defined external to the housing and having an essentially volumetric extent, and

wherein the collimated scanning pattern is characterized by at least one scanning plane having an essentially planar extent, and wherein the object detection field spatially encompasses at least a portion of the collimated scanning pattern.

49. The automatic projection laser scanning system of claim 45, wherein the laser beam generator is operated in a pulsed laser mode so as to generate a pulsed visible laser beam, which is directed through the light transmission aperture and repeatedly scanned across the collimated scanning pattern and the bar code symbol on the detected object.

50. The automatic projection laser scanning system of claim 49, wherein the object detector includes

a transmitter for transmitting a pulse signal through a first optical element and into the scanning volume,

5 a signal receiver for receiving the transmitted pulse signal reflected off the object in the scanning volume, and

a signal comparator for comparing the received pulse signal with the transmitted pulse signal and automatically generating an activation signal indicative of the presence of the object in the scanning volume.

51. The automatic projection laser scanning system of claim 50, wherein the transmitter comprises an infra-red light source in the hand-supportable housing for producing an infra-red light pulse which is transmitted through the first optical element into the scanning volume, and  
5 wherein the receiver comprises an infra-red light detector and a second optical element for focusing reflected infra-red light pulses onto the infra-red light detector.

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